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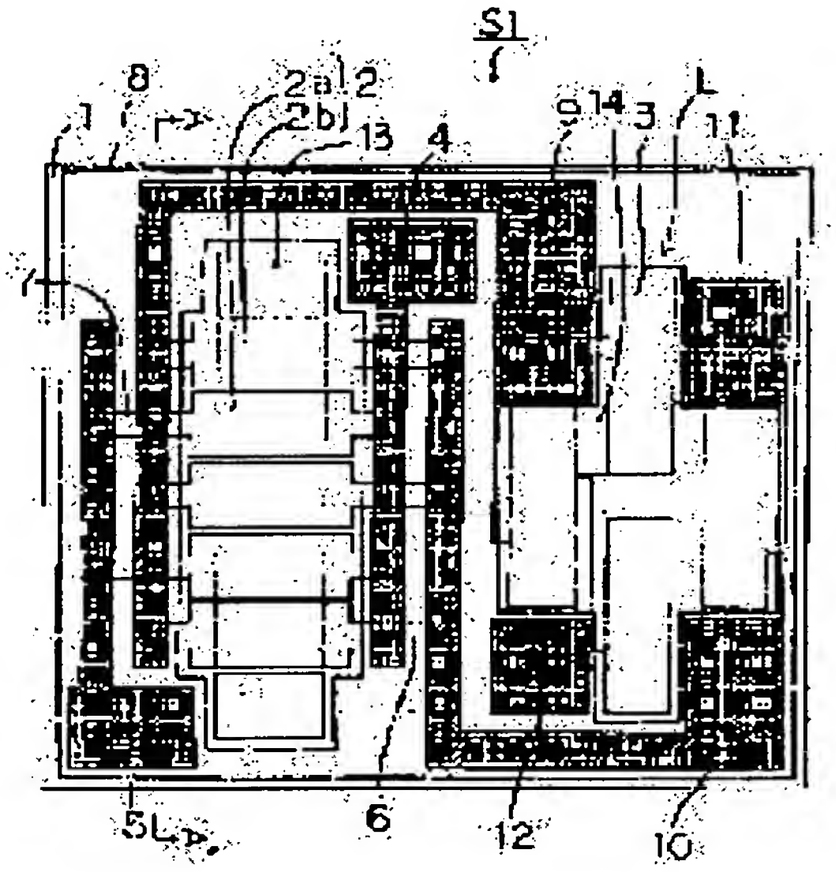
(54) SURFACE ACOUSTIC WAVE FILTER AND ITS MANUFACTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain such a structure that a balanced surface acoustic wave filter which has a reliable electric power resistance and a smooth passing characteristic for its passing band can be manufactured in a small size and the influences of processes on its characteristics can be reduced.
SOLUTION: A surface acoustic wave filter S1 is constituted by connecting in parallel lattice type circuits L, in each of which surface acoustic wave resonators 3 each composed of a plurality of IDT electrode are connected to each other in a symmetric lattice, or ladder type circuits, in each of which the surface acoustic wave resonators 3 are connected in a ladder, on the input or output sides of IIDT electrodes 2 constituted by alternately juxtaposing plural IDT electrodes 2a for input and plural IDT electrodes 2b for output through wiring patterns. The IIDT electrodes 2 and extended electrode extensions 6 and 7 of the lattice circuits L are arranged on wiring patterns 4, 5, 9, 10, 11, and 12 and an insulating layer 8 disposed on the patterns.



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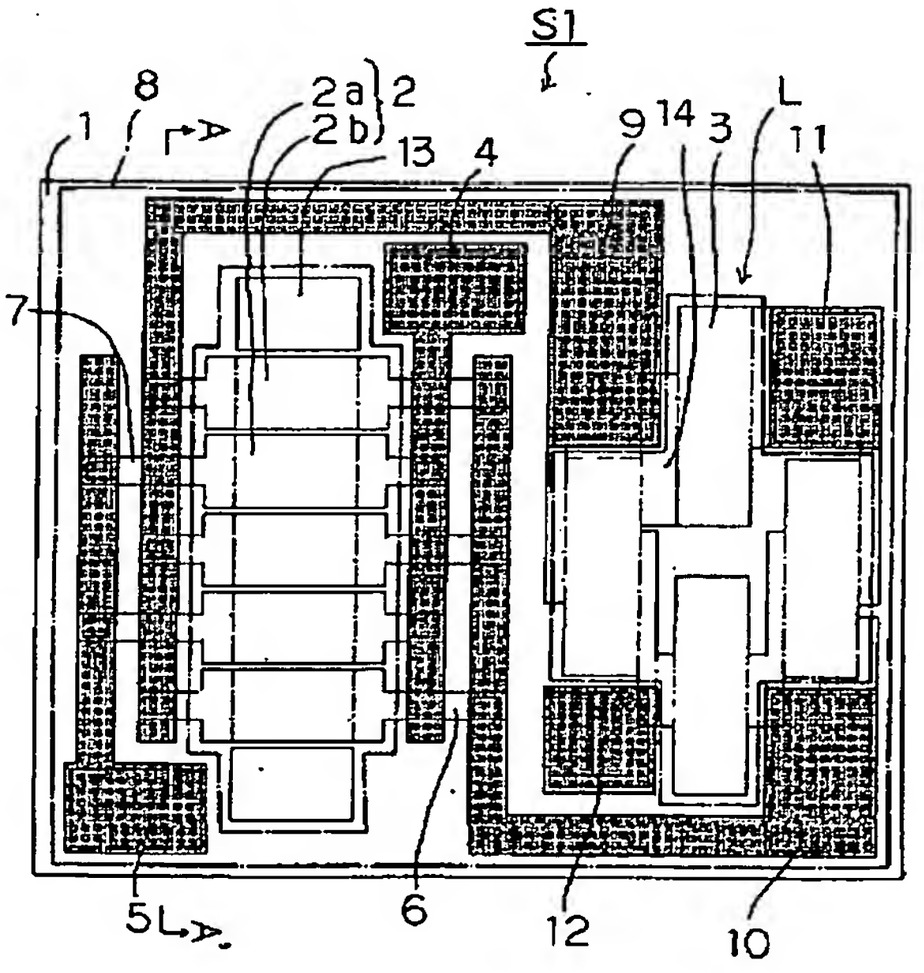
(54) 【発明の名称】弾性表面波フィルタ及びその製造方法

(57) 【要約】

【課題】　耐電力に対して信頼性があり、通過帯域の平滑な通過特性である平衡型弾性表面波フィルタを小型に作製でき、プロセスによる特性への影響を小さくする構造が得られるようにすること。

【解決手段】　複数の入力用ＩＤＴ電極２ａと複数の出力用ＩＤＴ電極２ｂとを交互に並設したＩＩＤＴ電極２の入力又は出力側に、複数のＩＤＴ電極から成る弾性表面波共振子３どうしを対称格子状に接続したラティス型回路Ｌ、又は複数のＩＤＴ電極から成る弾性表面波共振子を梯子状に接続したラダー型回路を配線パターンを介して接続して成るSAW フィルタＳ１とし、ＩＩＤＴ電極２とラティス型回路Ｌの電極延在部６，７が、配線パターン４，５，９，１０，１１，１２上、及びこれらの配線パターン上に設けた絶縁層８上に配設する。



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【特許請求の範囲】

【請求項１】　複数の入力用ＩＤＴ電極と複数の出力用ＩＤＴ電極とを交互に並設したＩＩＤＴ電極の入力又は出力側に、複数のＩＤＴ電極から成る弾性表面波共振子どうしを対称格子状に接続したラティス型回路、又は複数のＩＤＴ電極から成る弾性表面波共振子を梯子状に接続したラダー型回路を配線パターンを介して接続して成り、前記ＩＩＤＴ電極と前記ラティス型回路又はラダー型回路の電極延在部が、前記配線パターン上、及び該配線パターン上に設けた絶縁層上に配設されていることを特徴とする弾性表面波フィルタ。

【請求項２】　前記ＩＩＤＴ電極と前記ラティス型回路又はラダー型回路上に下記式を満足する保護層が積層されてなることを特徴とする請求項１に記載の弾性表面波フィルタ。

$1\times10^{9}\ \Omega \leqq \rho/h \leqq 1\times10^{13}\Omega$

（ただし、ρ：保護層の比抵抗値、ｈ：膜厚）

【請求項３】　複数の入力用ＩＤＴ電極と複数の出力用ＩＤＴ電極とを交互に並設したＩＩＤＴ電極の入力又は出力側に、複数のＩＤＴ電極から成る弾性表面波共振子どうしを対称格子状に接続したラティス型回路、又は複数のＩＤＴ電極から成る弾性表面波共振子を梯子状に接続したラダー型回路を接続して成る弾性表面波フィルタの製造方法であって、前記ＩＩＤＴ電極と前記ラティス型回路又はラダー型回路とを接続する配線パターンを形成する工程、少なくとも前記ＩＩＤＴ電極と前記ラティス型回路又はラダー型回路との接続部を除く領域に絶縁層を形成する工程、及び前記ＩＩＤＴ電極と前記ラティス型回路又はラダー型回路とを形成する工程を順次行うようにしたことを特徴とする弾性表面波フィルタの製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、例えば自動車電話及び携帯電話等の移動体無線機器に内蔵される周波数帯域フィルタに関し、特に不平衡平衡変換型の弾性表面波フィルタに関する。

【０００２】

【従来の技術】従来の弾性表面波（Surface Acoustic Wave ：以下、SAW と略す）装置の基本構成は、圧電基板上に一対の櫛歯状電極（Inter Digital Transducerで、以下、IDT 電極と略す）を１つ以上配設され、このIDT 電極から励起されるのSAW の伝搬路上に、SAW を効率良く共振させるための反射器がその両端に配設される。

【０００３】IDT 電極及び反射器は、例えば36° Y カットX 伝搬タンタル酸リチウム単結晶等からなる圧電基板上に、蒸着法，スパッタ法等の薄膜形成法により、AlやAl-Cu 合金等の導電物がフォトリソグラフィ法で微細な電極パターンに形成され作製される。

【０００４】また、この移動体通信機器等の小型・軽量化及び低コスト化のための使用部品点数削減により、SAW フィルタに新たな機能の付加が要求されている。その一つに、受送信号周波数のダウンコンバート及びアップコンバートを行なうミキサICの平衡入出力端に、不平衡入力－平衡出力又は平衡入力－不平衡出力の電気接続が可能なSAW フィルタ（以下、平衡型SAW フィルタという）が望まれている。また、ミキサICにより平衡端で終端される公称抵抗値は変化するため、この抵抗値に合わせて平衡型SAW フィルタの平衡端接続抵抗を設計する必要がある。

【０００５】従来のSAW フィルタは、一般に不平衡入力－不平衡出力しかできない接続構造であるため（例えば、特開平５－１８３３８０号公報等を参照）、SAW フィルタとミキサICの間にバランと呼ばれる平衡－不平衡変換器を介して接続する。

【０００６】また、平衡型SAW フィルタとして、例えば図１１に示すように、帯域外減衰量を向上させるため、鏡面対称に２つの共振子型フィルタ７１，７２を接続した弾性表面波フィルタＪ０が知られている（特開平８－６５０９４号公報等を参照）。このような共振器型フィルタにおいては平衡入出力に対応できるものの、SAWのエネルギーが共振器型フィルタの中に蓄積させ、特にRFブロックの帯域フィルタを形成するように構成するため、IDT 電極の櫛歯のピッチを非常に小さくししなければならないが、これにより、RFブロックに電力を印加した場合、電極のマイグレーションでフィルタ特性が劣化することがあり、信頼性上大きな問題となる。

【０００７】これらの問題点を解決するため、まずSAW フィルタに印加される電力を分散させるべく、多数の共振子を用いて構成させた複合共振子型SAW フィルタ構造と、平衡型SAW フィルタとして、IDT 電極を入出力１つ置きに載置したマルチ電極（Inter-degitated Inter Digital Transducerで、以下、IIDT電極と略す）を複合させて構成し、電圧を分散させ耐電力性を向上させる必要がある。

【０００８】また、IIDT電極はIDT 電極の構成が多数であるため、従来から行われていたAlワイヤやAuワイヤによる配線が複雑であり、このワイヤとIIDT電極を接続させるパッド部も多大な面積が必要となる。

【０００９】そこで本出願人は、図６に示すように、圧電基板５１上に複数の入力用IDT 電極５２ａと複数の出力用IDT 電極５２ｂとを交互に並設したIIDT電極５２の入力又は出力側に、複数のIDT 電極から成る弾性表面波共振子５３どうしを対称格子状に接続したラティス型回路Ｌ又は複数のIDT 電極から成る弾性表面波共振子を梯子状に接続したラダー型回路を接続して成る弾性表面波フィルタＪを提案している。なお、５４は入力電極、５５は接地電極、５６は入力側立体配線部、５７は出力側立体配線部、５８は絶縁層、５９，６０はラティス型回路Ｌの入力電極、６１，６２は平衡出力対の電極であ

る。

【００１０】

【発明が解決しようとする課題】しかしながら、上記のようなフィルタを立体配線接続する場合、まず図７に示すようにＩＩＤＴ５２及び弾性表面波共振子５３を圧電基板５１上に形成し、次に、その上に図８に示す絶縁層５８を形成し、最後に、図９に示す入力電極５４、接地電極５５、格子型電極の入力電極５９，６０、平衡出力対の一方の電極６１、平衡出力対のもう一方の電極６２を形成する構造であるので、絶縁層５８が適度に厚くないと層間絶縁の効果が十分発揮することができなくなり、逆に各弾性表面波共振子上の絶縁層５８が厚すぎると、フィルター特性が劣化してしまうという問題があった。

【００１１】また、上記構造の場合、櫛歯電極の形成後に絶縁層５８で保護してから配線等を形成すると、櫛歯電極上の絶縁層５８に一度電極材料の成膜とエッチングの工程がなされるため、どうしても絶縁層５８の表面がエッチングされ、周波数が変化するなどの問題が生ずる。

【００１２】

【課題を解決するための手段】上記課題を解決するため、本発明の弾性表面波フィルタは、複数の入力用ＩＤＴ電極と複数の出力用ＩＤＴ電極とを交互に並設したＩＩＤＴ電極の入力又は出力側に、複数のＩＤＴ電極から成る弾性表面波共振子どうしを対称格子状に接続したラティス型回路、又は複数のＩＤＴ電極から成る弾性表面波共振子を梯子状に接続したラダー型回路を配線パターンを介して接続して成り、ＩＩＤＴ電極と前記ラティス型回路又はラダー型回路の電極延在部が、配線パターン上、及び該配線パターン上に設けた絶縁層上に配設されていることを特徴とする。

【００１３】また、ＩＩＤＴ電極とラティス型回路又はラダー型回路上に下記式を満足する保護層が積層されてなることを特徴とする。

【００１４】$1\times10^{9}\ \Omega \leqq \rho/h \leqq 1\times10^{13}\ \Omega$

（ただし、ρ：保護層の比抵抗値、ｈ：膜厚）

また、本発明の弾性表面波フィルタの製造方法は、複数の入力用ＩＤＴ電極と複数の出力用ＩＤＴ電極とを交互に並設したＩＩＤＴ電極の入力又は出力側に、複数のＩＤＴ電極から成る弾性表面波共振子どうしを対称格子状に接続したラティス型回路、又は複数のＩＤＴ電極から成る弾性表面波共振子を梯子状に接続したラダー型回路を接続して成る製造方法であって、ＩＩＤＴ電極とラティス型回路又はラダー型回路とを接続する配線パターンを形成する工程、少なくともＩＩＤＴ電極とラティス型回路又はラダー型回路との接続部を除く領域に絶縁層を形成する工程、及びＩＩＤＴ電極とラティス型回路又はラダー型回路とを形成する工程を順次行うようにしたことを特徴とする。

【００１５】

【発明の実施の形態】本発明に係るSAW フィルタの実施形態を図面に基づき詳細に説明する。

【００１６】図１に示すように、本発明のSAW フィルタＳ１は、複数の入力用ＩＤＴ電極２ａと複数の出力用ＩＤＴ電極２ｂとを交互に並設したＩＩＤＴ電極２の入力又は出力側に、複数のＩＤＴ電極から成る弾性表面波共振子３どうしを対称格子状に接続したラティス型回路Ｌ、又は複数のＩＤＴ電極から成る弾性表面波共振子を梯子状に接続したラダー型回路を配線パターンを介して接続して成るものである。また、図５に示すように、ＩＤＴ電極２とラティス型回路Ｌ又はラダー型回路の電極延在部６，７が、配線パターン４，５，９，１０，１１，１２上、及びこれらの配線パターン上に設けた絶縁層８上に配設されている。

【００１７】また、図５に示すように、ＩＩＤＴ電極とラティス型回路Ｌ又はラダー型回路上に保護層１５が積層されていてもよい。

【００１８】ここで、圧電基板１は、36° ±３° Y カットX 伝搬タンタル酸リチウム単結晶、42° ±３° Y カットX 伝搬タンタル酸リチウム単結晶、64° ±３° Y カットX伝搬ニオブ酸リチウム単結晶、41° ±３° Y カットX伝搬ニオブ酸リチウム単結晶、45° ±３° X カットZ伝搬四ホウ酸リチウム単結晶等が好適に使用でき、これらの圧電基板は電気機械結合係数が大きく且つ周波数温度係数が小さいため好ましい。この圧電基板１の厚みは０．１～０．５mm程度が良く、０．１mm未満では圧電基板が脆くなり、０．５mm超では材料コストと部品寸法が大きくなり使用できない。

【００１９】また、IDT 電極２及び反射器１３は、Al若しくはAl合金（Al-Cu 系、Al-Ti 系等）から成り、蒸着法、スパッタリング法、またはCVD 法等の薄膜形成法により形成する。そして、IDT 電極２は、対数３０～２００対程度、IDT 電極ピッチは０．４μm～２０μm程度、交差幅（開口幅）は１０μm～５００μm程度、IDT 電極厚みは０．１μm～０．５μm程度とすることがSAW フィルタとしての特性を得る上で好適である。

【００２０】４は入力電極用配線パターン、５は接地電極用配線パターン、６は入力側立体接続配線部、７は接地側立体接続配線部である。このような構成により、入力電極用配線パターン４及び接地電極用配線パターン５にRF電気信号を加え、立体配線された構造を持つIIDT電極２に電気信号が加えられる。

【００２１】また、絶縁層８はSiO_2，SiN，又はAl_2O_3 等の１種以上から成る絶縁薄膜とする。

【００２２】また、本特許に係るSAW フィルタ素子の電極及び圧電基板上のＳＡＷ伝搬部にSi、SiO_2、SiN、Al_2O_3 を保護層１５として形成し、導電性異物による通電防止や耐電力向上を行うとよい。ここで、保護層１５の膜厚は１５ｎｍ～７５ｎｍが好ましい。１５ｎｍよ

り薄いと保護層としての機能をはたさなく、７５ｎｍより厚いとフィルターの挿入損失が大きくなるという問題が生じる。

【００２３】また、この時の保護層の比抵抗値をρ、膜厚をｈとしたときρ／ｈが1×10^{9}～$1\times10^{13}\Omega$であると、焦電性による電極間の放電を防止することができる。

【００２４】また、上記弾性表面波フィルタＳ１は、少なくとも以下の工程により製造される。まず、図２に示すように、ＩＩＤＴ電極２とラティス型回路Ｌ又はラダー型回路とを接続する配線パターン４，５，９，１０，１１，１２を形成する工程を行う。次に、少なくともＩＩＤＴ電極２とラティス型回路Ｌ又はラダー型回路との接続部を除く領域に絶縁層８を図３に示すようなパターンに形成する工程を行う。そして、図４に示すように、ＩＩＤＴ電極２とラティス型回路Ｌ又はラダー型回路とを形成する工程を行うようにしている。

【００２５】かくして得られた弾性表面波フィルタＳ１によれば、図１０に示すように、少なくとも中心周波数８００ＭＨｚ～２．５ＧＨｚの範囲における規格化周波数（周波数を中心周波数で割った値）での減衰量から、帯域内偏差の小さな非常に良好な特性が得られた。

【００２６】

【実施例】図１に示したように、入力側にIIDT電極型を出力側に格子接続の共振子を配置させ、これらの配線は図１の６、７の構造によりワイヤによる配線を簡便化した設計を行った。IIDT電極の電極線幅は１．１μｍであり、格子型に構成された直列腕共振子のＩＤＴ電極の線幅は１．０５μｍであり、また格子腕共振子のＩＤＴ電極の線幅は１．１μｍとした。また、電極膜厚は３２００Åであり、全櫛歯状電極ピッチの平均値λと櫛歯状電極の電極膜厚ｈとの比は７．４％とした。

【００２７】具体的な作製方法を、以下に説明する。

【００２８】42° Y カットX 伝搬タンタル酸リチウム単結晶から成る圧電基板上に、前記構造、前記共振子電極詳細を網羅する回路パターンを形成することにより作製した。まず洗浄した基板にレジストを約１μｍの膜厚で塗布し、 N_2 雰囲気中でベークを行った。

【００２９】次に、紫外線(Deep-UV) を用いた密着露光機によるフォトリソグラフィー法により基板上に多数のSAW フィルタのレジストのネガパターンを形成した。この時、フォトマスクは厚み0.25インチのものを使用した。

【００３０】次に、ネガパターン上に電子ビーム蒸着機でAlを成膜した。その後、レジスト剥離液中で不要なAlをリフトオフし、図２に示す概略形状のAl電極パターンを作製した。次に、スパッタリング法 SiO_2 を成膜した。

【００３１】その後、レジストを約１μｍの膜厚で塗布し、 N_2 雰囲気中でベークを行った。次に、紫外線(Deep-UV) を用いた密着露光機によるフォトリソグラフィー法により基板上に図３のパターンにレジストを形成した。CF_4 と O_2 を主成分とするガスでＲＩＥをおこない、 SiO_2 をパターニングした。

【００３２】次に、電子ビーム蒸着機でAlを成膜した。再度上記と同様のフォトリソグラフィー技術を用い、多数のSAW フィルタのレジストのパターンを形成した。Alのエッチングは BCl_3 とCl_2 と N_2 ガスを用いてRIE 法により行った。その後、レジスト剥離液中で不要なAlをリフトオフし、IDT 電極等の微細な回路パターンを作製した。その後、IDT 電極をネットワークアナライザに接続し、挿入損失の周波数特性を測定した。

【００３３】その結果、中心周波数８００ＭＨｚ～２．５ＧＨｚの範囲において帯域内偏差は１．２ｄＢ であり、良好な特性を得られた。

【００３４】

【発明の効果】以上説明したように、本発明の弾性表面波フィルタ及びその製造方法によれば、配線パターンの形成後に絶縁層と電極層にて立体配線されるようにしたので、絶縁層を十分に厚くすることができ、電極間容量を小さくできる。また層間絶縁層として十分な機能を持たせることができ、優れた弾性表面波フィルタを提供することができる。

【００３５】また、絶縁層が微細なＩＤＴ電極のエッチング工程にさらされることがなく、周波数変化などの特性変化のない信頼性の優れた弾性表面波フィルタを提供することができる。

【００３６】さらに、弾性表面波共振子上に厚い絶縁層を設ける必要がなく、これによる特性の劣化の心配がない上、弾性表面波共振子上に最適な保護層を形成することにより、信頼性や特性の優れた弾性表面波フィルタを提供することができる。

【図面の簡単な説明】

【図１】本発明に係る弾性表面波フィルタを模式的に示す概略平面図である。

【図２】本発明に係る弾性表面波フィルタの圧電基板上第１層めの平面図である。

【図３】本発明に係る弾性表面波フィルタの圧電基板上第２層めの平面図である。

【図４】本発明に係る弾性表面波フィルタの圧電基板上第３層めの平面図である。

【図５】図１におけるＡ－Ａ’線断面図である。

【図６】弾性表面波フィルタを模式的に示す概略平面図である。

【図７】図５に示す弾性表面波フィルタの圧電基板上第１層めの平面図である。

【図８】図５に示す弾性表面波フィルタの圧電基板上第２層めの平面図である。

【図９】図５に示す弾性表面波フィルタの圧電基板上第３層めの平面図である。

【図１０】本発明の弾性表面波フィルタの特性図である。

【図１１】従来の共振器型フィルタの構造を示す平面図である。

【符号の説明】

１：圧電基板

２：ＩＩＤＴ電極

３：格子型電極

４：入力電極

５：接地電極

６：入力側立体配線部

７：接地側立体配線部

８：絶縁層

９，１０：ラティス型回路の入力電極

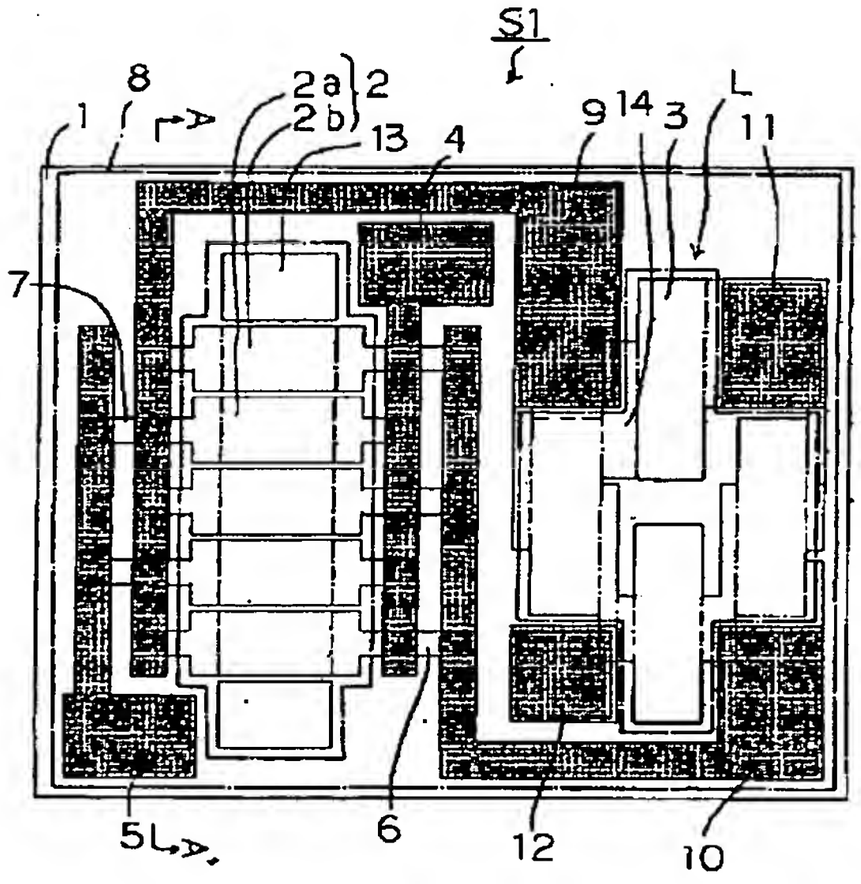
１１：平衡出力対の一方の電極

１２：平衡出力対の他方の電極

１５：保護層

Ｓ１：弾性表面波フィルタ

【図１】



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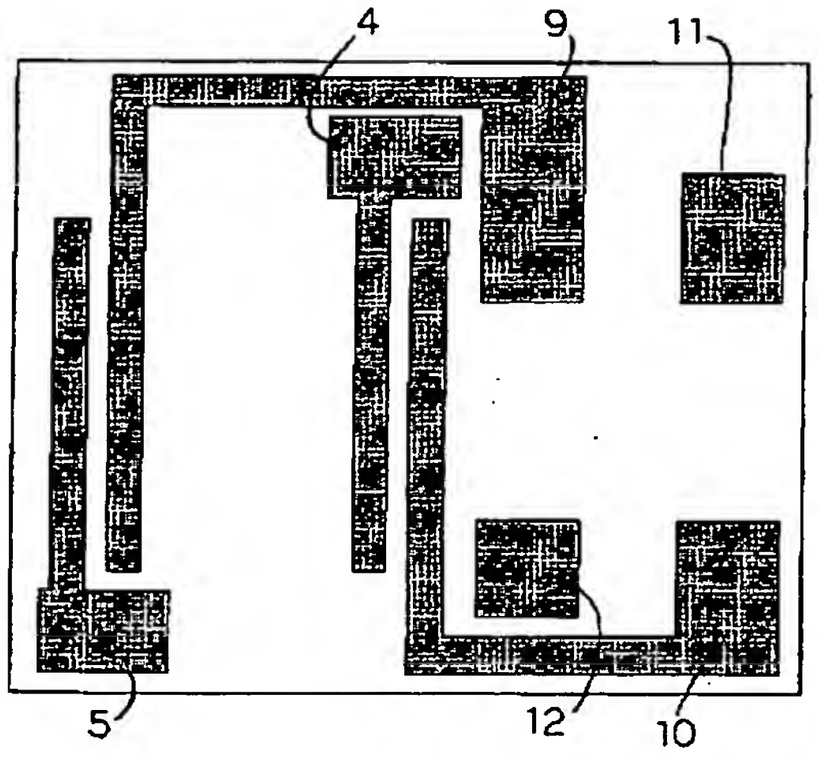
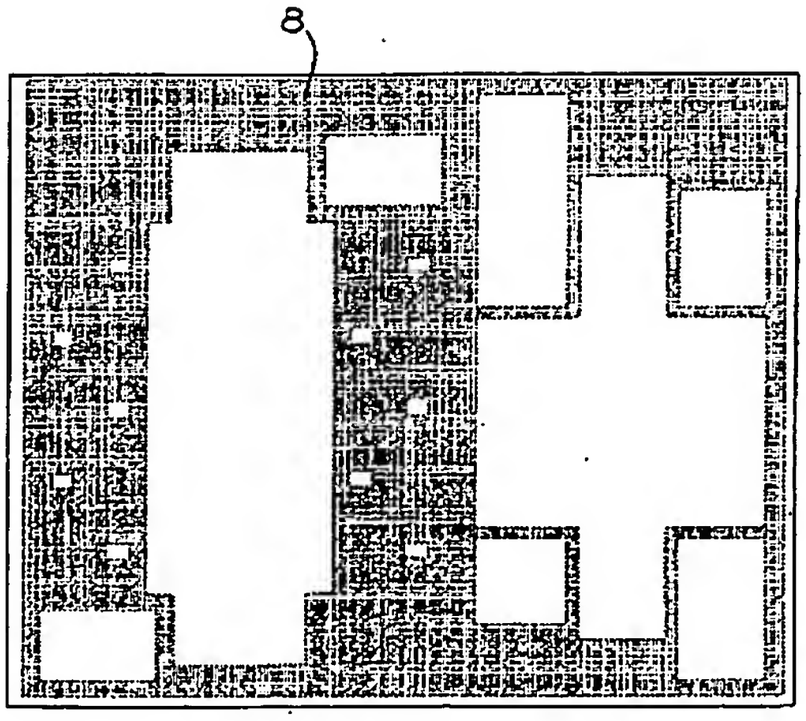
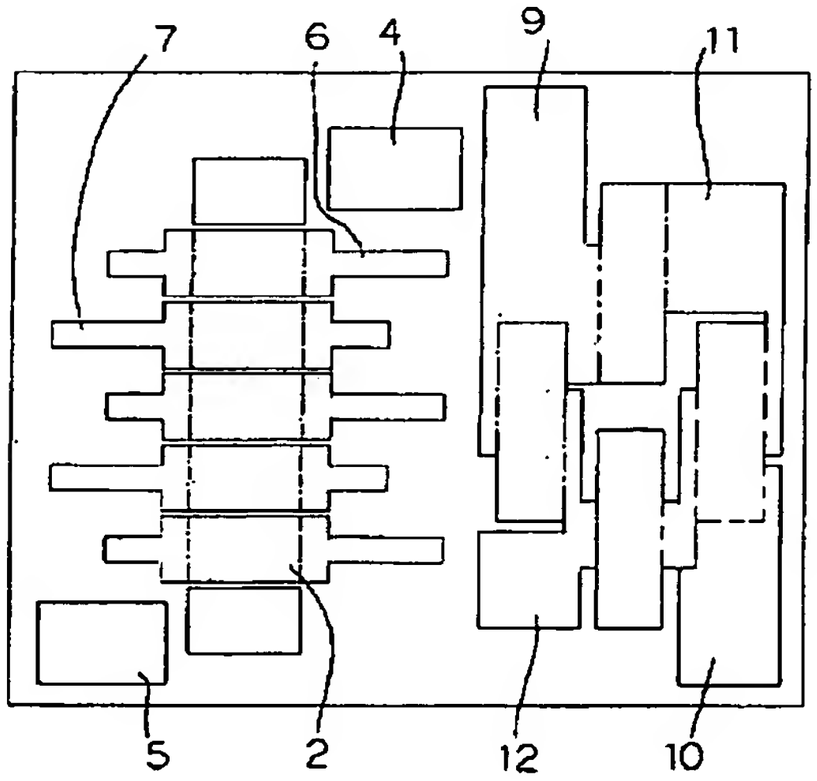


【図３】



【図４】



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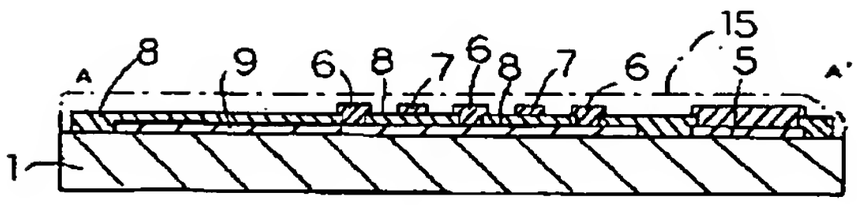
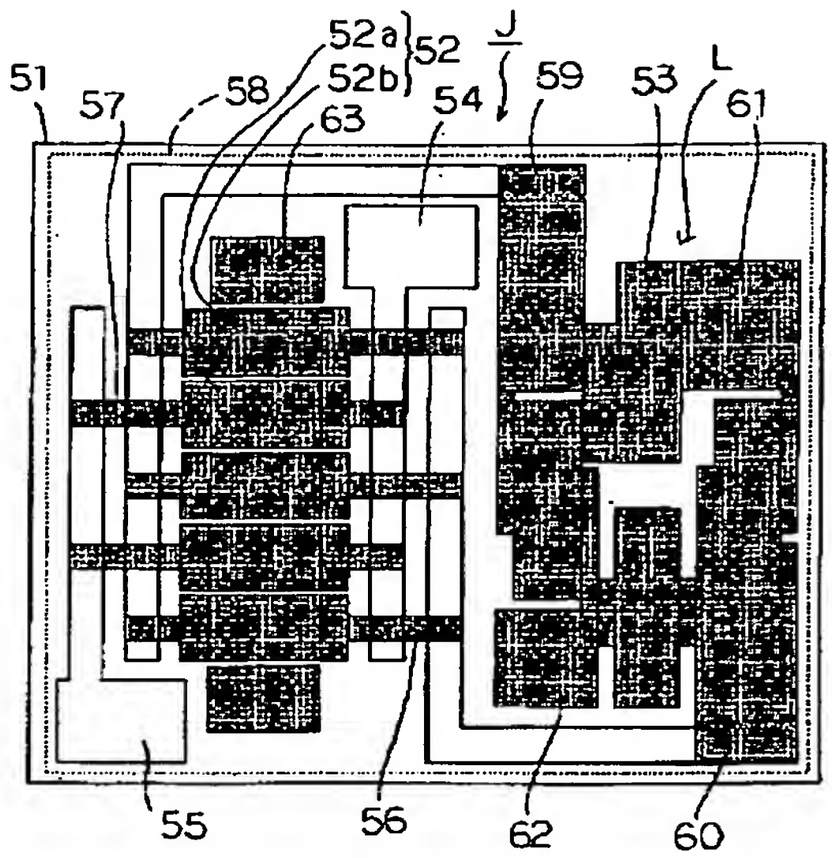
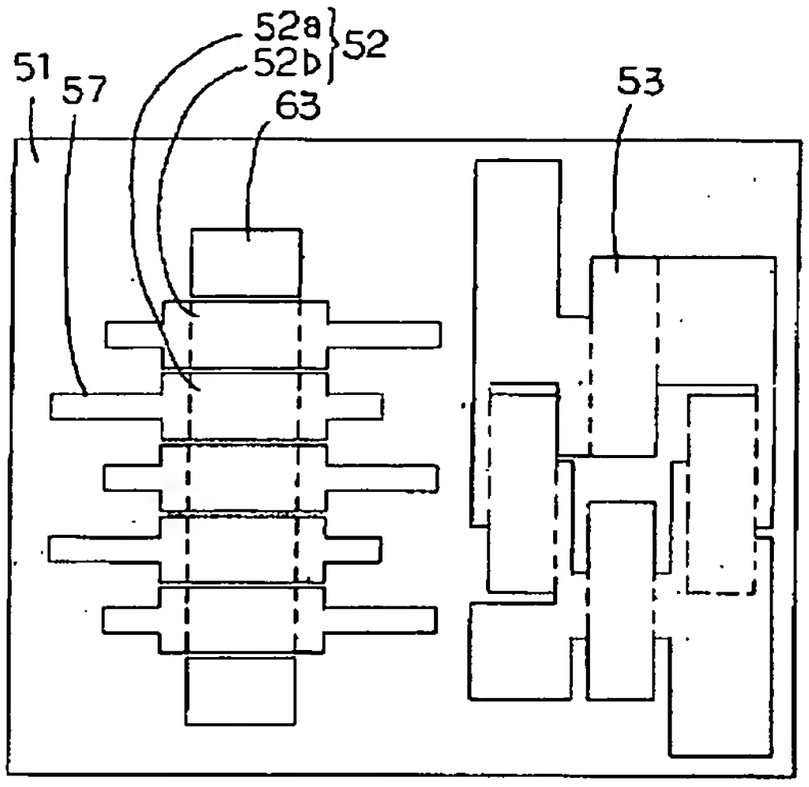

15
A
8
9
6
8
7
6
8
7
6
5
A'
1

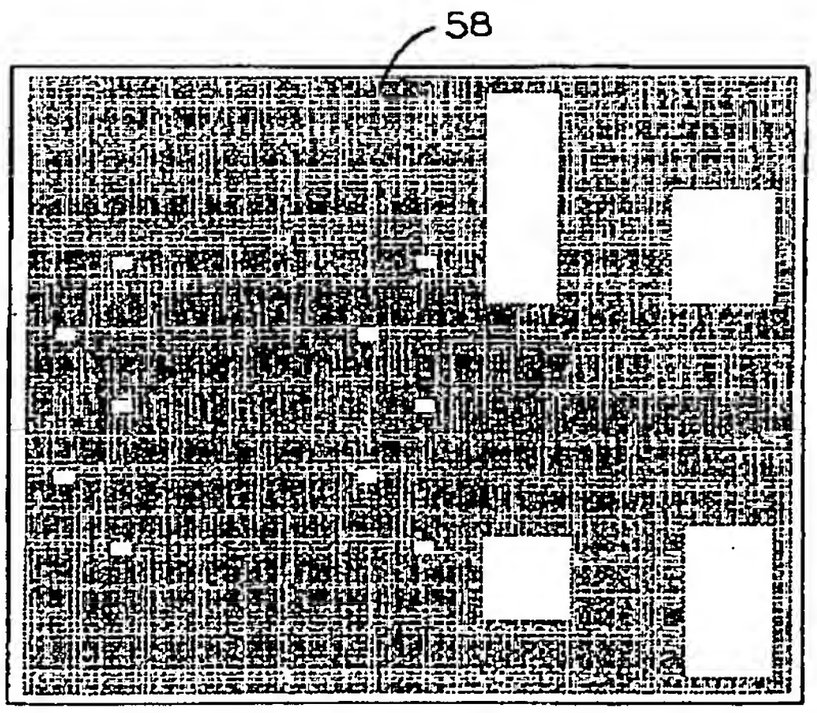
【図６】


52a
52b
52
J
51
57
58
63
54
59
53
L
61
55
56
62
60

【図７】


52a
52b
52
51
57
63
53

【図８】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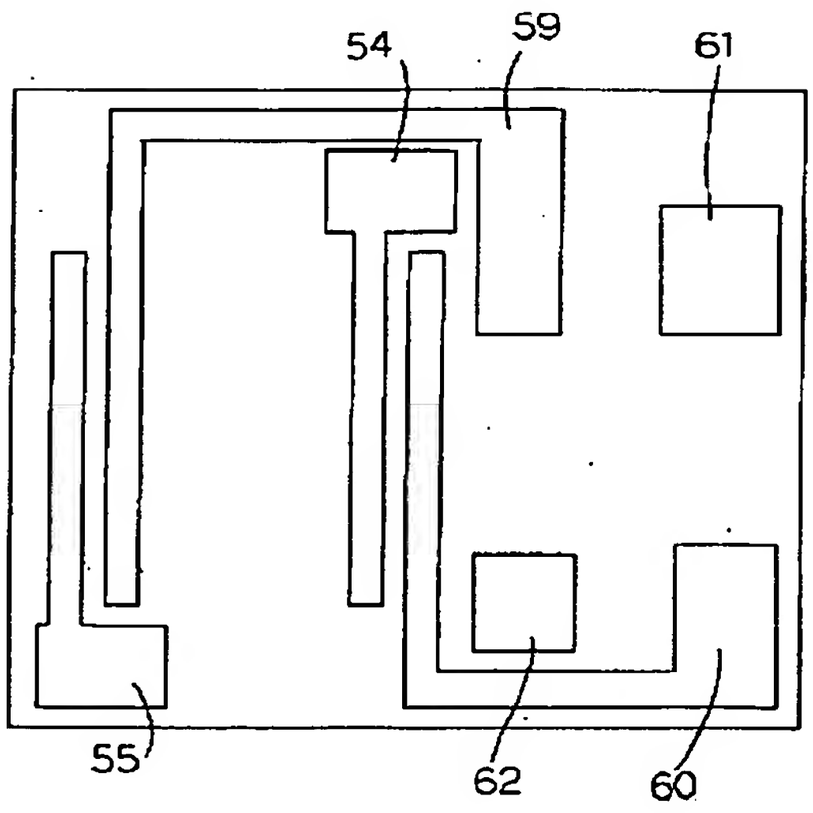
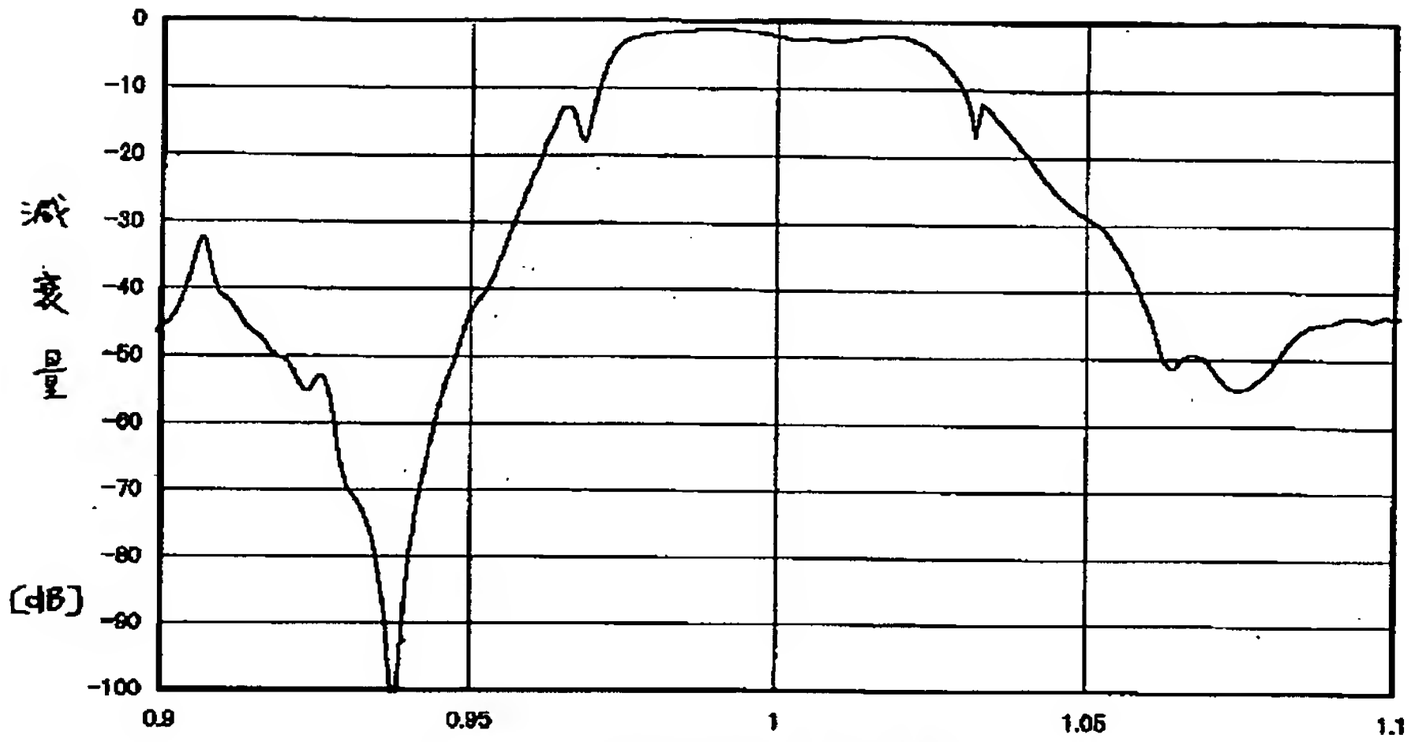
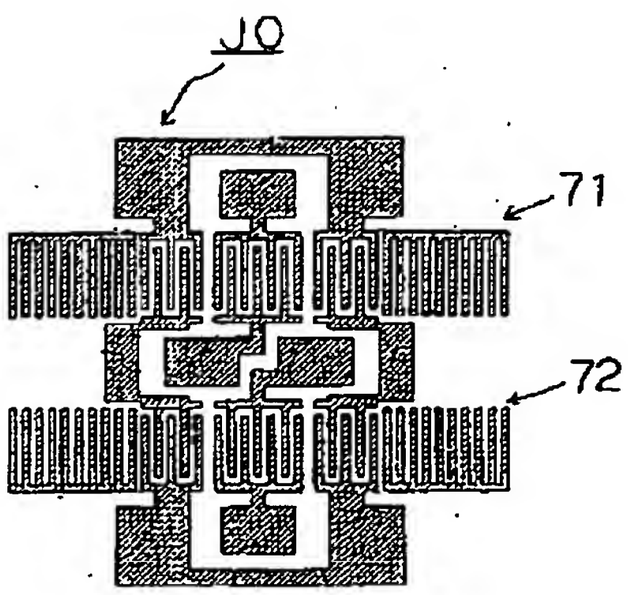
【図９】


54
59
61
55
62
60

【図１０】



【図１１】



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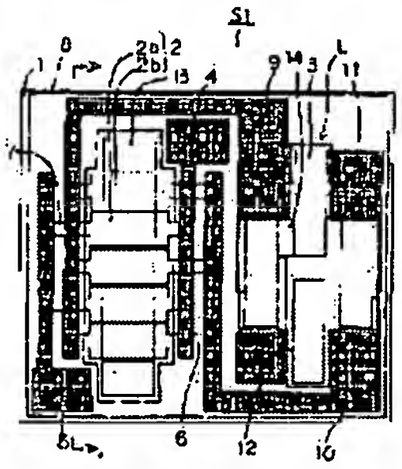
(54) SURFACE ACOUSTIC WAVE FILTER AND ITS MANUFACTURE



(57)Abstract:

PROBLEM TO BE SOLVED: To obtain such a structure that a balanced surface acoustic wave filter which has a reliable electric power resistance and a smooth passing characteristic for its passing band can be manufactured in a small size

and the influences of processes on its characteristics can be reduced.
SOLUTION: A surface acoustic wave filter S1 is constituted by connecting in parallel lattice type circuits L, in each of which surface acoustic wave resonators 3 each composed of a plurality of IDT electrode are connected to each other in a symmetric lattice, or ladder type circuits, in each of which the surface acoustic wave resonators 3 are connected in a ladder, on the input or output sides of IIDT electrodes 2 constituted by alternately juxtaposing plural IDT electrodes 2a for input and plural IDT electrodes 2b for output through wiring patterns. The IIDT electrodes 2 and extended electrode extensions 6 and 7 of the lattice circuits L are arranged on wiring patterns 4, 5, 9, 10, 11, and 12 and an insulating layer 8 disposed on the patterns.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]

[Claim 1] To the input or output side of an IIDT electrode which installed two or more IDT electrodes for an input, and two or more IDT electrodes for an output by turns The lattice mold circuit which connected the surface acoustic wave resonators which consist of two or more IDT electrodes in the shape of a symmetry grid, Or connect the ladder mold circuit which connected the surface acoustic wave resonator which consists of two or more IDT electrodes in the shape of a ladder through a circuit pattern, and it changes. The surface acoustic wave filter characterized by arranging the electrode extension section of said IIDT electrode, said lattice mold circuit, or a ladder mold circuit on the insulating layer prepared on said circuit pattern and this circuit pattern.

[Claim 2] The surface acoustic wave filter according to claim 1 characterized by coming to carry out the laminating of the protective layer which satisfies the following type on said IIDT electrode, said lattice mold circuit, or a ladder mold circuit.

1x109 Omega<=rho/h <=1x1013ohm (however, resistivity of rho:protective layer, h: thickness)

[Claim 3] To the input or output side of an IIDT electrode which installed two or

more IDT electrodes for an input, and two or more IDT electrodes for an output by turns The lattice mold circuit which connected the surface acoustic wave resonators which consist of two or more IDT electrodes in the shape of a symmetry grid, Or it is the manufacture approach of the surface acoustic wave filter which connects the ladder mold circuit which connected the surface acoustic wave resonator which consists of two or more IDT electrodes in the shape of a ladder, and changes. The process which forms the circuit pattern which connects said IIDT electrode, said lattice mold circuit, or a ladder mold circuit, The process which forms an insulating layer in the field except a connection with said IIDT electrode, said lattice mold circuit, or a ladder mold circuit at least, And the manufacture approach of the surface acoustic wave filter characterized by performing the process which forms said IIDT electrode, said lattice mold circuit, or a ladder mold circuit one by one.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the surface acoustic wave filter of

an unbalance balance conversion mold especially about the frequency band filter built in mobile wireless devices, such as a land mobile radiotelephone and a cellular phone.

[0002]

[Description of the Prior Art] One or more ctenidium-like electrodes (it is Inter Digital Transducer and they are the following and IDT it abbreviates to an electrode) of a pair are arranged on a piezo-electric substrate, and the basic configuration of conventional surface acoustic wave (it abbreviates to SAW below Surface Acoustic Wave :) equipment is this IDT. It is excited [SAW] from an electrode. On a propagation path, it is SAW. The reflector for making it resonate efficiently is arranged in those both ends.

[0003] IDT An electrode and a reflector are 36degreeY. Cut X On the piezo-electric substrate which consists of a propagation lithium tantalate single crystal etc., they are aluminum and aluminum-Cu by the thin film forming methods, such as vacuum deposition and a spatter. Electric conduction objects, such as an alloy, are formed and produced by the detailed electrode pattern by the photolithography method.

[0004] Moreover, it is SAW by the use components mark reduction for small and lightweight-izing of this mobile communication equipment etc., and low-cost-izing. Addition of a new function is demanded of the filter. It is SAW in which the electrical connection of an unbalanced input-balanced output or a balanced input-unbalanced output is possible to the balanced I/O edge of the mixer IC which performs a down convert and rise convert of a carrier transmitting number frequency to one of them. A filter (the following and balanced type SAW it is called a filter) is desired. Moreover, in order to change, it doubles with this resistance, and the rated resistance by which termination is carried out at a balanced edge with Mixer IC is a balanced type SAW. It is necessary to design balanced end connection resistance of a filter.

[0005] The conventional SAW Since it is the connection structure which can generally perform only an unbalanced input-unbalanced output (see JP,5-

183380,A etc.), a filter is SAW. It connects through balanced - unbalance converter called a balun between a filter and Mixer IC.

[0006] Moreover, balanced type SAW As a filter, as shown in drawing 11 , in order to raise the magnitude of attenuation out of band, the surface acoustic wave filter J0 which connected two resonator mold filters 71 and 72 to mirror symmetry is known (see JP,8-65094,A etc.). Since it constitutes so that the energy of SAW may make it accumulate into a resonator mold filter and may form especially the band-pass filter of RF block although it can respond to balanced I/O in such a resonator mold filter, it is IDT. Thereby, although the pitch of the ctenidium of an electrode must be made very small and must be carried out, when power is impressed to RF block, a filter shape may deteriorate in the migration of an electrode and it becomes a big problem on dependability.

[0007] In order to solve these troubles, it is SAW first. Compound resonator mold SAW made to constitute using many resonators in order to have distributed the power impressed to a filter Filter structure, Balanced type SAW As a filter, it is IDT. Multi-electrode which laid the electrode every other I/O (by Inter-degitated Inter Digital Transducer) a following and IIDT electrode -- omitting -- it is necessary to make it compound, to constitute and to distribute an electrical potential difference, and it necessary to raise power-proof nature

[0008] Moreover, an IIDT electrode is IDT. Much configurations of an electrode come out, for a certain reason, wiring with aluminum wire and Au wire which were performed from the former is complicated, and area also with the great pad section which connects an IIDT electrode to this wire is needed.

[0009] Then, these people are IDT for an input of plurality [top / piezo-electric / substrate 51], as shown in drawing 6 . Electrode 52a and two or more IDT(s) for an output To the input or output side of the IIDT electrode 52 installed by turns, electrode 52b Two or more IDT(s) The lattice mold circuit L or two or more IDT(s) which connected surface acoustic wave resonator 53 which consist of an electrode in the shape of a symmetry grid The surface acoustic wave filter J which connects the ladder mold circuit which connected the surface acoustic

wave resonator which consists of an electrode in the shape of a ladder, and changes is proposed. In addition, for an input electrode and 55, as for the input-side solid wiring section and 57, an earth electrode and 56 are [54 / the output side solid wiring section and 58] an insulating layer and the electrode of a balanced output pair [62 / the input electrode of the lattice mold circuit L and / 61 and 62 / 60 / 59 and].

[0010]

[Problem(s) to be Solved by the Invention] However, when making solid wiring connection of the above filters, as first shown in drawing 7 , IIDT52 and the surface acoustic wave resonator 53 are formed on the piezo-electric substrate 51. Next, since it is the structure which forms on it the insulating layer 58 shown in drawing 8 , and finally forms the input electrode 54 shown in drawing 9 , an earth electrode 55, the input electrodes 59 and 60 of a skeleton pattern electrode, one electrode 61 of a balanced output pair, and another electrode 62 of a balanced output pair If an insulating layer 58 was not moderately thick, it becomes impossible for the effectiveness of layer insulation to have demonstrated enough, and when the insulating layer 58 on each surface acoustic wave resonator was too thick conversely, there was a problem that a filter shape will deteriorate.

[0011] Moreover, if in the case of the above-mentioned structure wiring etc. is formed after protecting by the insulating layer 58 after formation of a ctenidium electrode, since membrane formation of an electrode material and the process of etching will be once made by the insulating layer 58 on a ctenidium electrode, the front face of an insulating layer 58 is surely etched, and the problem of a frequency changing arises.

[0012]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the surface acoustic wave filter of this invention To the input or output side of an IIDT electrode which installed two or more IDT electrodes for an input, and two or more IDT electrodes for an output by turns The lattice mold circuit which connected the surface acoustic wave resonators which consist of two or

more IDT electrodes in the shape of a symmetry grid, Or connect the ladder mold circuit which connected the surface acoustic wave resonator which consists of two or more IDT electrodes in the shape of a ladder through a circuit pattern, and it changes. The electrode extension section of an IIDT electrode, said lattice mold circuit, or a ladder mold circuit is characterized by being arranged on the insulating layer prepared on the circuit pattern and this circuit pattern.

[0013] Moreover, it is characterized by coming to carry out the laminating of the protective layer which satisfies the following type on an IIDT electrode, a lattice mold circuit, or a ladder mold circuit.

[0014] 1x109 Omega<=rho/h <=1x1013ohm (however, resistivity of rho:protective layer, h: thickness)

Moreover, the manufacture approach of the surface acoustic wave filter of this invention To the input or output side of an IIDT electrode which installed two or more IDT electrodes for an input, and two or more IDT electrodes for an output by turns The lattice mold circuit which connected the surface acoustic wave resonators which consist of two or more IDT electrodes in the shape of a symmetry grid, Or it is the manufacture approach which connects the ladder mold circuit which connected the surface acoustic wave resonator which consists of two or more IDT electrodes in the shape of a ladder, and changes. The process which forms the circuit pattern which connects an IIDT electrode, a lattice mold circuit, or a ladder mold circuit, It is characterized by performing the process which forms the process which forms an insulating layer in the field except a connection with an IIDT electrode, a lattice mold circuit, or a ladder mold circuit at least and an IIDT electrode and a lattice mold circuit, or a ladder mold circuit one by one.

[0015]

[Embodiment of the Invention] SAW concerning this invention The operation gestalt of a filter is explained to a detail based on a drawing.

[0016] As shown in drawing 1 , it is SAW of this invention. A filter S1 To the input or output side of the IIDT electrode 2 installed by turns, two or more IDT

electrode 2a for an input, and two or more IDT electrode 2bs for an output The ladder mold circuit which connected the surface acoustic wave resonator which consists of the lattice mold circuit L or two or more IDT electrodes which connected surface acoustic wave resonator 3 which consist of two or more IDT electrodes in the shape of a symmetry grid in the shape of a ladder is connected through a circuit pattern, and it changes. Moreover, as shown in drawing 5 , the electrode extension sections 6 and 7 of the IIDT electrode 2, the lattice mold circuit L, or a ladder mold circuit are arranged on the insulating layer 8 prepared on circuit patterns 4, 5, 9, 10, and 11, 12, and these circuit patterns.

[0017] Moreover, as shown in drawing 5 , the laminating of the protective layer 15 may be carried out on the IIDT electrode, the lattice mold circuit L, or the ladder mold circuit.

[0018] Here, the piezo-electric substrate 1 is a 36 degree**3 degreeY propagation lithium niobate single crystal and 45 degree**3 degreeX cut Z. Cut X A propagation lithium tantalate single crystal and 42degree**3degreeY Cut X A propagation lithium tantalate single crystal and 64degree**3degreeY A cut X propagation lithium niobate single crystal and 41degree**3degreeY Cut X A propagation tetraboric-acid lithium single crystal etc. can use it suitably, and since [that an electromechanical coupling coefficient is large and] these piezo-electric substrates have the small frequency temperature coefficient, they are desirable. The thickness of this piezo-electric substrate 1 has about 0.1-0.5 goodmm, and by less than 0.1mm, a piezo-electric substrate cannot become weak, by 0.5mm **, ingredient cost and a components dimension become large and it cannot be used.

[0019] Moreover, IDT An electrode 2 and a reflector 13 consist of aluminum or aluminum alloy (aluminum-Cu a system and aluminum-Ti system etc.), and are vacuum deposition, the sputtering method, or CVD. It forms by the thin film forming methods, such as law. And IDT An electrode 2 is about 30-200 pairs of logarithms, and IDT. An electrode pitch is 0.4 micrometers - about 20 micrometers, and crossover width of face (aperture width) is 10 micrometers -

about 500 micrometers and IDT. For electrode thickness, it is SAW to be referred to as 0.1 micrometers - about 0.5 micrometers. It is suitable when acquiring the property as a filter.

[0020] For 4, as for the circuit pattern for earth electrodes, and 6, the circuit pattern for input electrodes and 5 are [the input-side solid connection wiring section and 7] the earth side solid connection wiring sections. An electrical signal is added to the IIDT electrode 2 with the structure in which added RF electrical signal to the circuit pattern 4 for input electrodes, and the circuit pattern 5 for earth electrodes, and solid wiring was carried out by such configuration.

[0021] moreover, the insulating layer 8 -- SiO 2, SiN, or aluminum 2O3 etc. -- it considers as the insulating thin film which consists of one or more sorts.

[0022] Moreover, SAW concerning this patent They are Si, SiO 2, SiN, and aluminum 2O3 to the SAW propagation section on the electrode of a filter element, and a piezo-electric substrate. It is good to form as a protective layer 15 and to perform the energization prevention and the improvement in power-proof by the conductive foreign matter. Here, the thickness of a protective layer 15 has 15nm - desirable 75nm. If thinner than 15nm, the function as a protective layer will not be achieved, and if thicker than 75nm, the problem that the insertion loss of a filter becomes large will arise.

[0023] Moreover, when resistivity of the protective layer at this time is set to rho and thickness is set to h, inter-electrode discharge according that rho/h is 1x109 to 1x1013ohms to pyroelectricity can be prevented.

[0024] Moreover, the above-mentioned surface acoustic wave filter S1 is manufactured according to the following processes at least. First, as shown in drawing 2 , the process which forms the circuit patterns 4, 5, 9, 10, 11, and 12 which connect the IIDT electrode 2, and the lattice mold circuit L or a ladder mold circuit is performed. Next, the process formed in a pattern as shows an insulating layer 8 at least to the field except the connection of the IIDT electrode 2, and the lattice mold circuit L or a ladder mold circuit at drawing 3 is performed. And as shown in drawing 4 , it is made to perform the process which forms the IIDT

electrode 2, and the lattice mold circuit L or a ladder mold circuit.

[0025] According to the surface acoustic wave filter S1 obtained in this way, as shown in drawing 10 , the very good property that the deflection in a band is small was acquired from the magnitude of attenuation in the normalized radiam frequency (value which divided the frequency by center frequency) in the range of 800MHz - 2.5GHz center frequency at least.

[0026]

[Example] As shown in drawing 1 , the resonator of the grid connection of an IIDT electrode mold with an output side was arranged to the input side, and these wiring performed the design which facilitated wiring with a wire according to 6 of drawing 1 , and the structure of 7. The electrode line breadth of an IIDT electrode is 1.1 micrometers, and the line breadth of the IDT electrode of the serial arm resonator constituted by the skeleton pattern is 1.05 micrometers, and line breadth of the IDT electrode of a grid arm resonator was set to 1.1 micrometers. Moreover, electrode layer thickness is 3200A and the average lambda of a total ctenidium-like electrode pitch and the ratio with the electrode layer thickness h of a ctenidium-like electrode could be 7.4%.

[0027] The concrete production approach is explained below.

[0028] 42degreeY Cut X It produced by forming the circuit pattern which covers said structure and said resonator electrode detail on the piezo-electric substrate which consists of a propagation lithium tantalate single crystal. a resist is applied to the substrate washed first by about 1-micrometer thickness -- N2 BEKU was performed in the ambient atmosphere.

[0029] Next, ultraviolet rays (Deep-UV) They are much SAW(s) on a substrate by the photolithography method by the used adhesion exposure machine. The negative pattern of the resist of a filter was formed. At this time, the photo mask used the thing with a thickness of 0.25 inches.

[0030] Next, aluminum was formed with the electron-beam-evaporation machine on the negative pattern. Then, lift off of the unnecessary aluminum was carried out in resist exfoliation liquid, and aluminum electrode pattern of the outline

configuration shown in drawing 2 was produced. Next, the sputtering method SiO2 Membranes were formed.

[0031] then, a resist is applied by about 1-micrometer thickness -- N2 BEKU was performed in the ambient atmosphere. Next, ultraviolet rays (Deep-UV) The resist was formed on the substrate by the photolithography method by the used adhesion exposure machine at the pattern of drawing 3 . CF4 O2 It is RIE with the gas used as a principal component A deed and SiO2 Patterning was carried out.

[0032] Next, aluminum was formed with the electron-beam-evaporation machine. The again same photolithography technique as the above is used, and they are much SAW(s). The pattern of the resist of a filter was formed. Etching of aluminum BCl3 Cl2 N2 Gas is used and it is RIE. It carried out by law. Then, lift off of the unnecessary aluminum is carried out in resist exfoliation liquid, and it is IDT. Detailed circuit patterns, such as an electrode, were produced. Then, IDT The electrode was connected to the network analyzer and the frequency characteristics of an insertion loss were measured.

[0033] consequently, the range of 800MHz - 2.5GHz center frequency -- setting -- the deflection in a band -- 1.2dB it is -- the good property was able to be acquired.

[0034]

[Effect of the Invention] Since solid wiring was made to be carried out in an insulating layer and an electrode layer after formation of a circuit pattern according to the surface acoustic wave filter and its manufacture approach of this invention as explained above, an insulating layer can be made thick enough and interelectrode capacity can be made small. Moreover, function sufficient as a layer insulation layer can be given, and the outstanding surface acoustic wave filter can be offered.

[0035] Moreover, the surface acoustic wave filter which was excellent in the dependability which an insulating layer is not exposed to the etching process of a detailed IDT electrode, and does not have property change, such as frequency change, can be offered.

[0036] Furthermore, when it is not necessary to prepare a thick insulating layer on a surface acoustic wave resonator and there are no worries about degradation of the property by this, the surface acoustic wave filter which was excellent in dependability or a property can be offered by forming the protective layer optimal on a surface acoustic wave resonator.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the outline top view showing typically the surface acoustic wave filter concerning this invention.

[Drawing 2] It is the top view of the 1st layer on the piezo-electric substrate of the surface acoustic wave filter concerning this invention.

[Drawing 3] It is the top view of the 2nd layer on the piezo-electric substrate of the surface acoustic wave filter concerning this invention.

[Drawing 4] It is the top view of the 3rd layer on the piezo-electric substrate of the surface acoustic wave filter concerning this invention.

[Drawing 5] It is an A-A' line sectional view in drawing 1 .

[Drawing 6] It is the outline top view showing a surface acoustic wave filter

typically.

[Drawing 7] It is the top view of the 1st layer on the piezo-electric substrate of the surface acoustic wave filter shown in drawing 5 .

[Drawing 8] It is the top view of the 2nd layer on the piezo-electric substrate of the surface acoustic wave filter shown in drawing 5 .

[Drawing 9] It is the top view of the 3rd layer on the piezo-electric substrate of the surface acoustic wave filter shown in drawing 5 .

[Drawing 10] It is the property Fig. of the surface acoustic wave filter of this invention.

[Drawing 11] It is the top view showing the structure of the conventional resonator mold filter.

[Description of Notations]

1: A piezo-electric substrate

2: IIDT electrode

3: Skeleton pattern electrode

4: Input electrode

5: Earth electrode

6: Input-side solid wiring section

7: Earth side solid wiring section

8: Insulating layer

9 10: The input electrode of a lattice mold circuit

11: One electrode of a balanced output pair

12: The electrode of another side of a balanced output pair

15: Protective layer

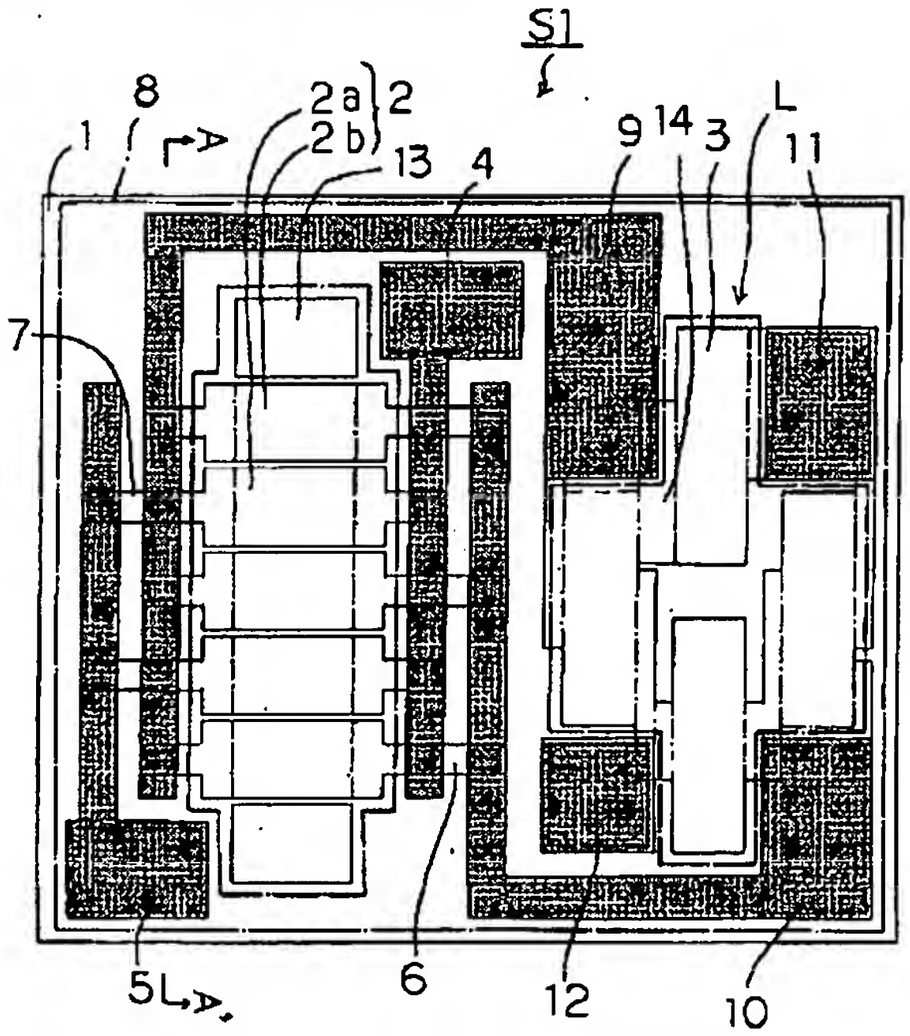
S1: Surface acoustic wave filter

[Translation done.]

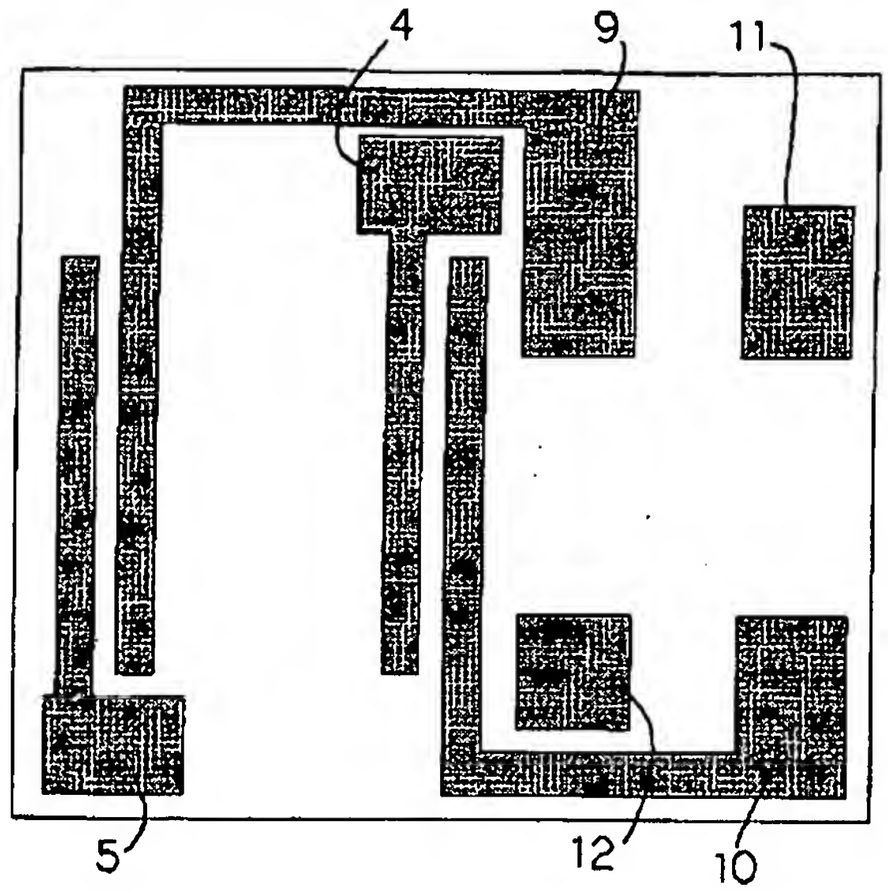
* NOTICES *

DRAWINGS

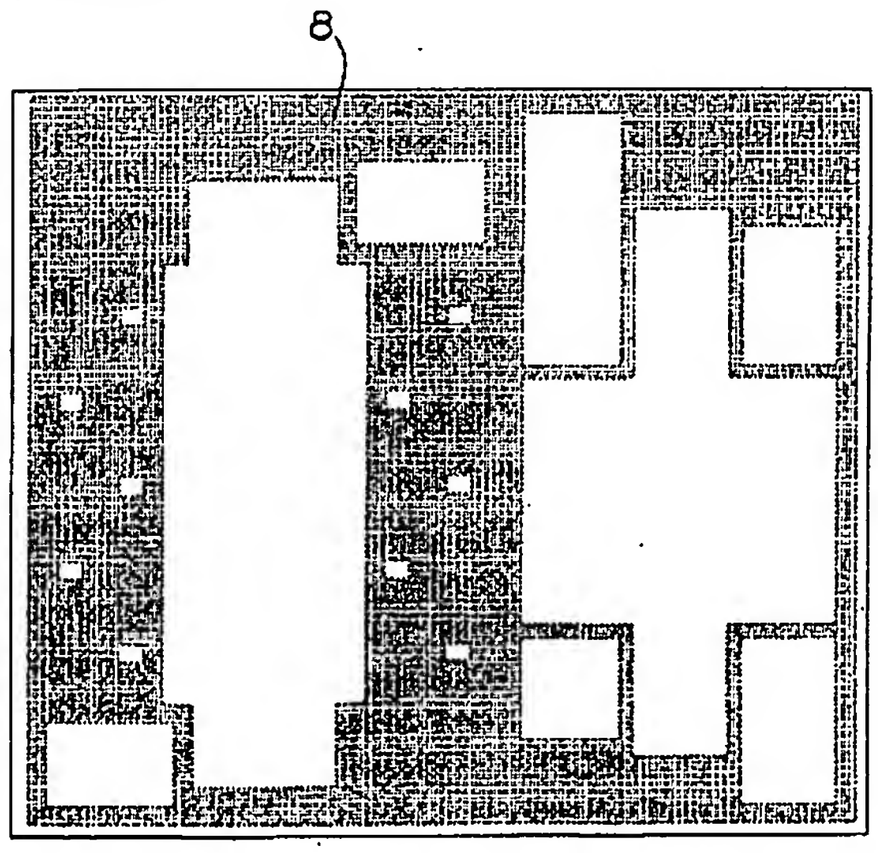
[Drawing 1]



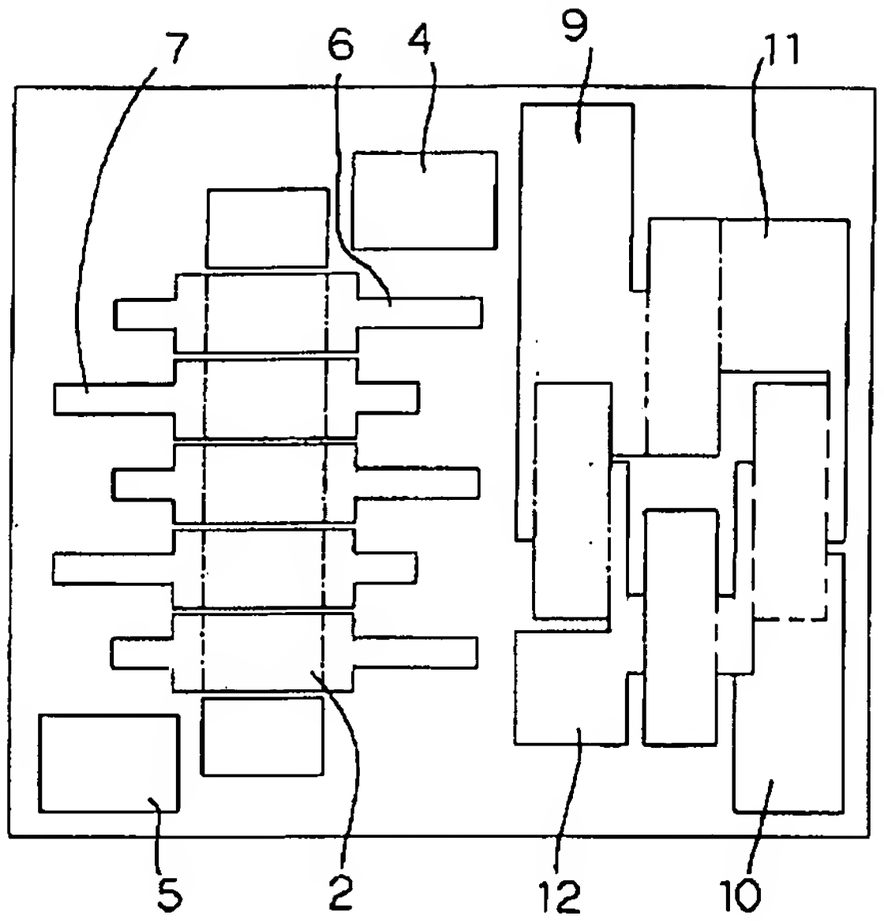
[Drawing 2]



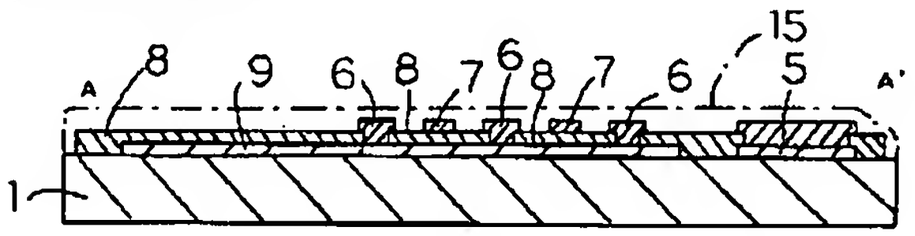
[Drawing 3]



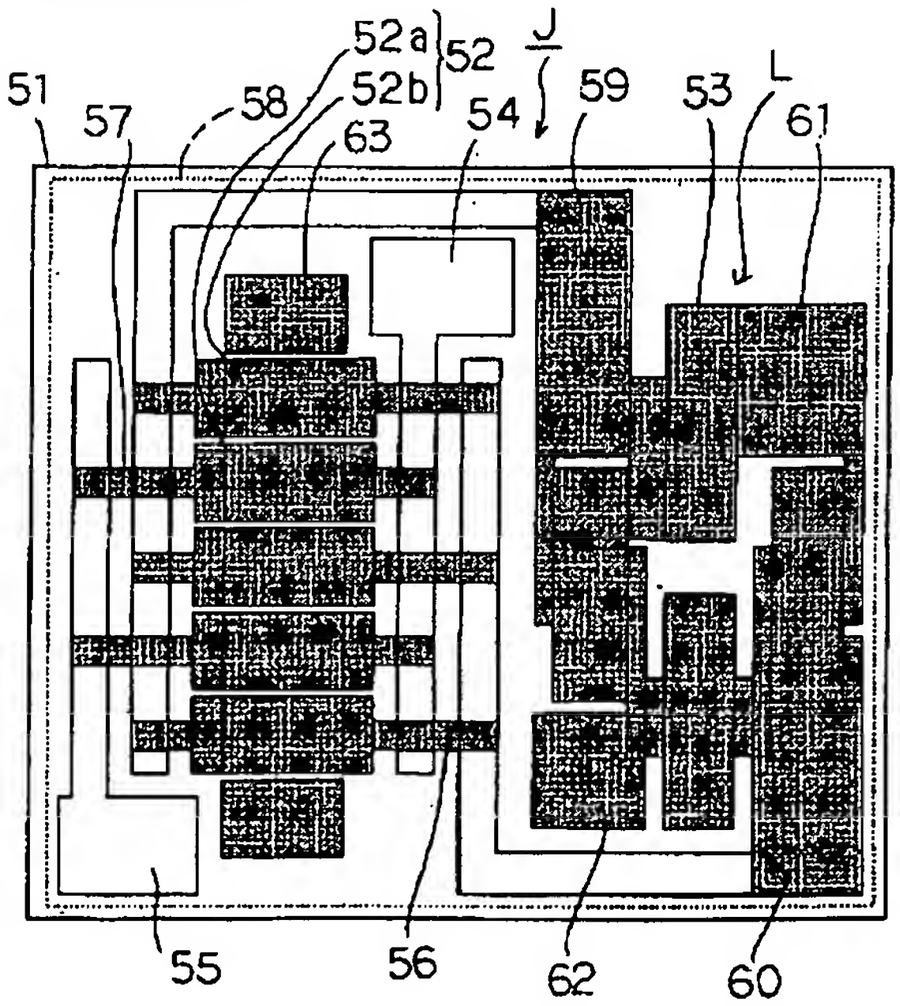
[Drawing 4]



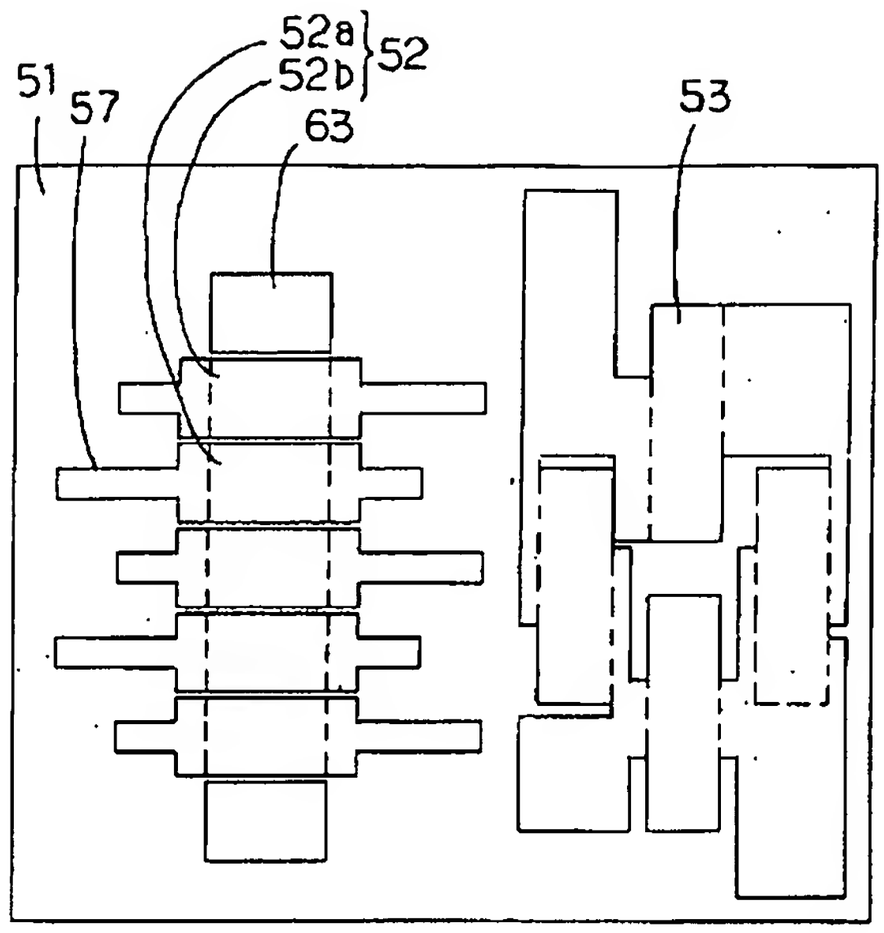
[Drawing 5]



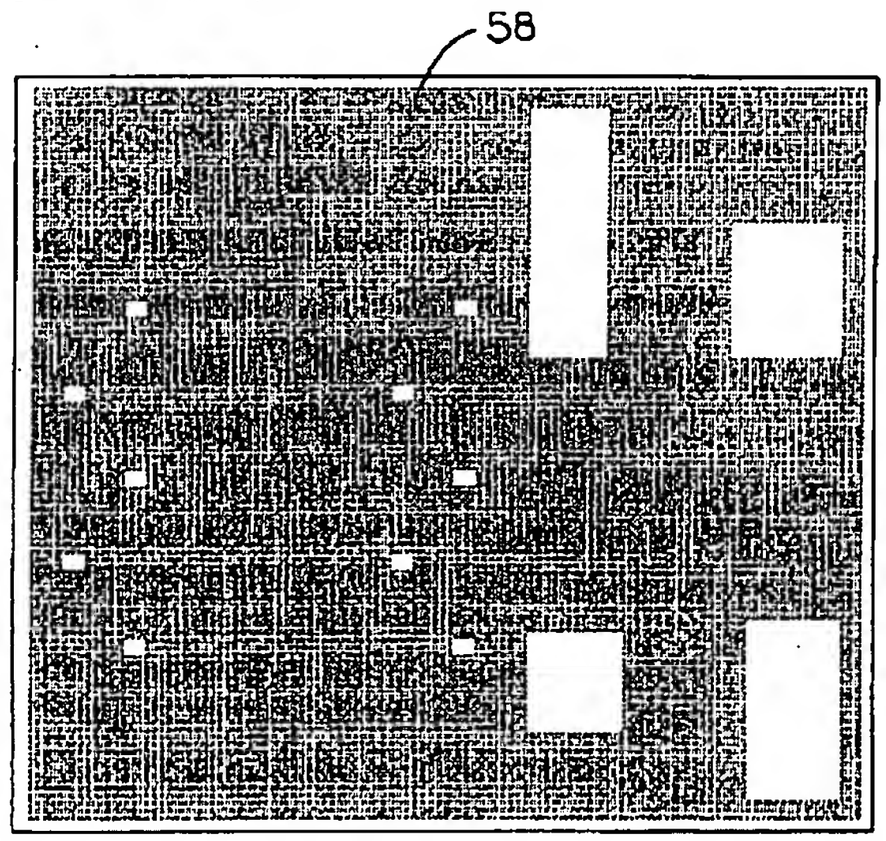
[Drawing 6]



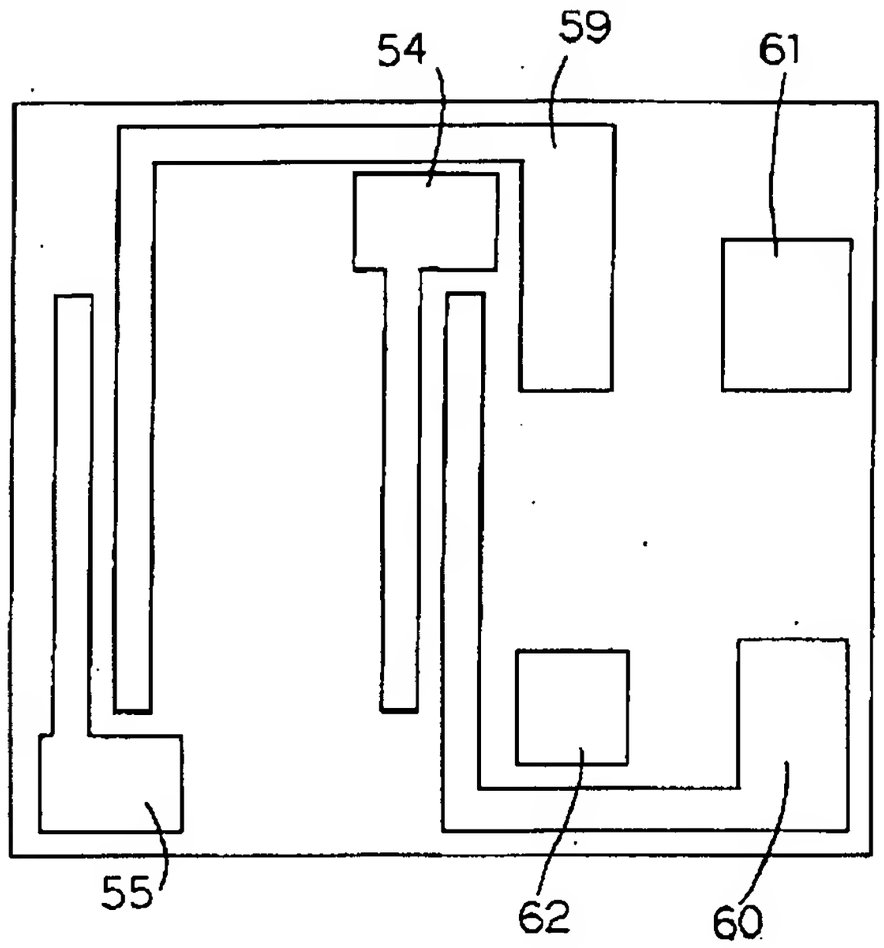
[Drawing 7]



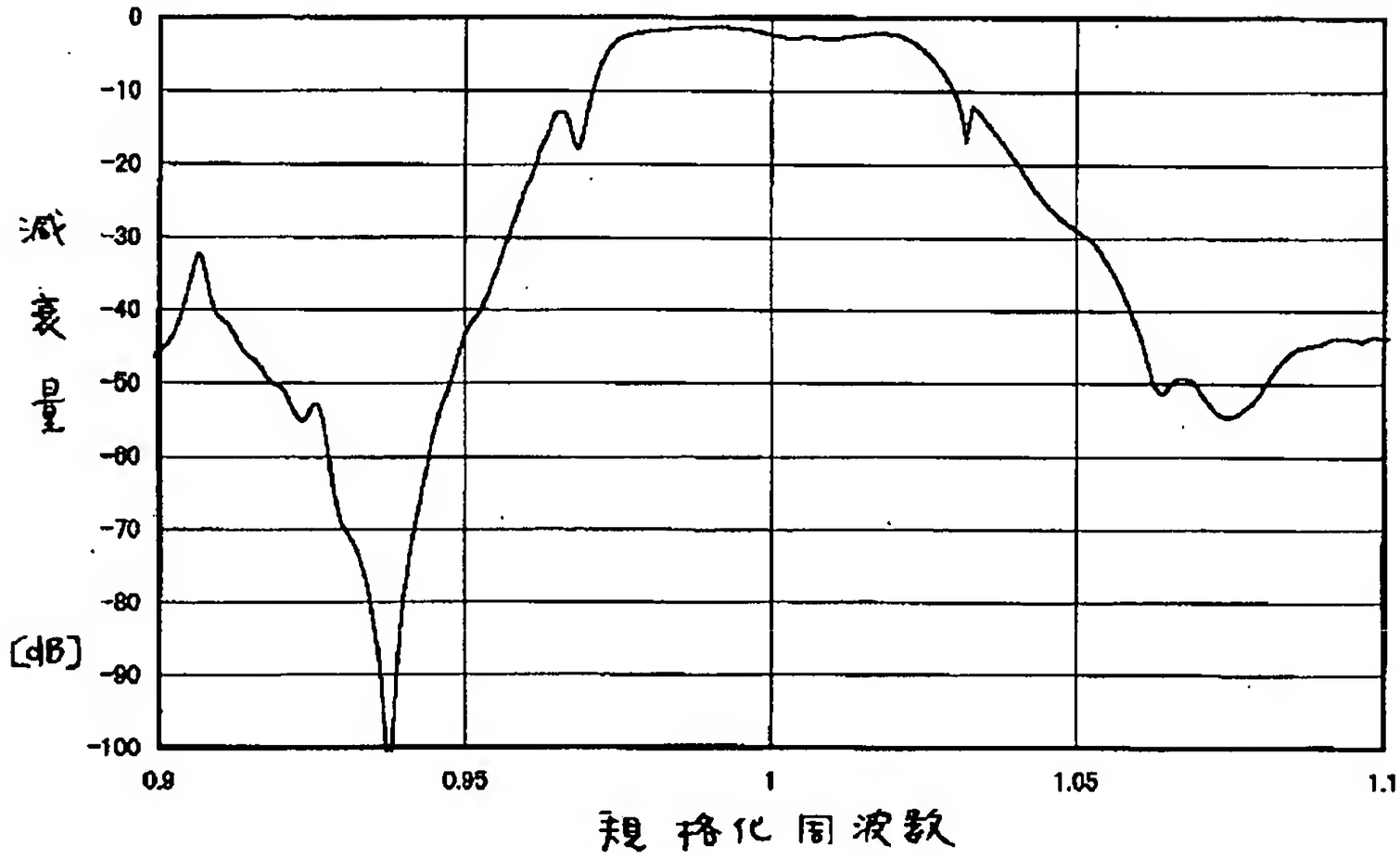
[Drawing 8]



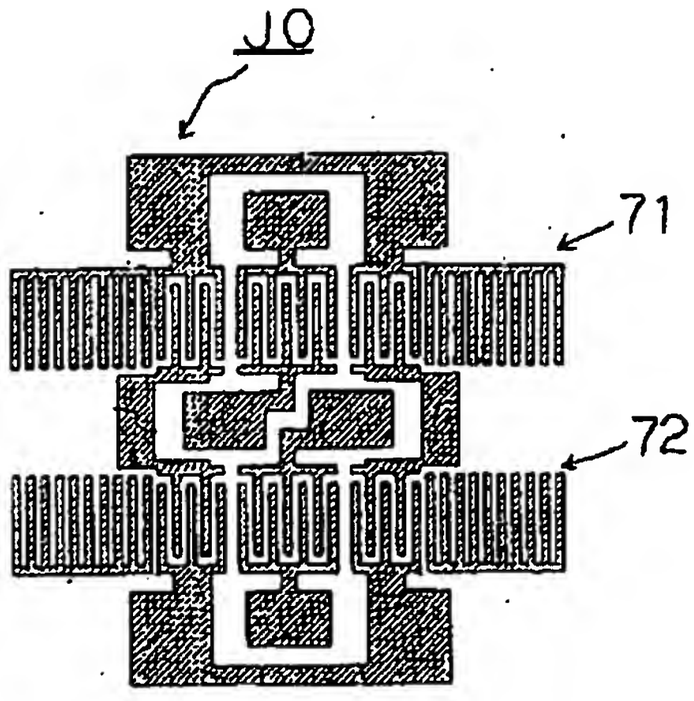
[Drawing 9]



[Drawing 10]



[Drawing 11]



[Translation done.]